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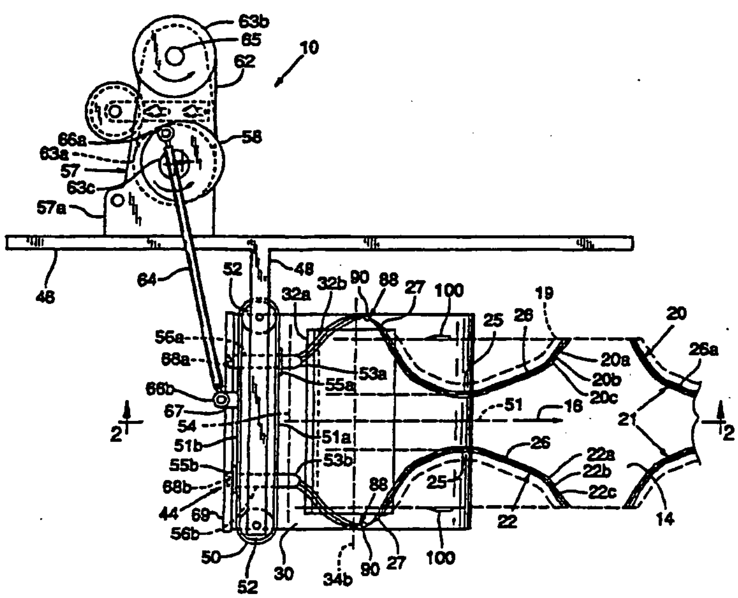

(57) Abstract

A machine (10) for applying elastic (20, 22) to material (14) is provided. A conveyor (28) moves the material (14) in one direction along a flow path (16). A plurality of elastic bands (20a, 20b, 20c, 22a, 22b, 22c) are provided for application onto the material (14). An elastic feeder (44) has feeder heads (53a, 53b) that feed the plurality of elastic bands (20a, 20b, 20c, 22a, 22b, 22c) directly onto the material (14) while the feeder heads (53a, 53b) move laterally across the flow path (16). The lateral movement of the feeder heads (53a, 53b) across the moving conveyor (28) applies the elastic bands (20a, 20b, 20c, 22a, 22b, 22c) onto the material (14) in a curved contour (21) while maintaining a selected perpendicular spacing between the elastic bands (20a, 20b, 20c, 22a, 22b, 22c).

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LEG ELASTIC APPLICATOR

FIELD OF THE INVENTION

The present invention is directed to apparatus and method for applying elastic to material, such as leg elastic on material for disposable diapers, training pants, and the like.

BACKGROUND AND SUMMARY OF THE INVENTION

This application is a continuation-in-part of prior application 08/233,247, filed on April 26, 1994.

Disposable absorbent garments, such as children's diapers and training pants, commonly incorporate elastic adjacent the leg openings of the garment for a snug fit that minimizes leakage from the garment leg region. The application of elastic along the leg openings in such garments has been the subject of a great deal of activity in the past.

In particular, elastic positioned along the leg openings in a curved contour has been found desirable in minimizing leakage. However, existing machines have not proved entirely satisfactory in economically applying elastic in curved patterns to such garments.

An object of the present invention is to provide a machine that applies elastic in an improved, curved contour to garment material.

Another object of the present invention is to provide a machine suitable for application of elastic at high working speeds.

It is a further object of the present invention to provide apparatus that economically applies such elastic.

A further object of the present invention is to provide apparatus that applies individual bands of elastic with selected spacing between the bands throughout the curved contour.

In accordance with the present invention, a machine for applying elastic to garment material is provided that includes a conveyor for carrying garment material. The conveyor moves in one direction along a flow path. An elastic band storage with a plurality of elongate elastic bands is provided for application to the garment material. An elastic feeder has a feeder head with guide points from which the elastic bands are fed. The feeder head moves laterally across the flow path to feed the plurality of elastic bands directly onto the garment material carried by the conveyor in a curved contour. The guide points are automatically repositionable in response to feeder head and conveyor speeds in order that the elastic bands are fed with a selected perpendicular spacing maintained between individual elastic bands throughout a range of feeder head and conveyor speeds.

Also in accordance with the present invention, a method is provided for applying elastic to garment material that includes the steps of moving the material in one direction along a flow path, providing a source of a plurality of elongate elastic bands, guiding the elastic bands directly onto the material in a pattern moving laterally across said material relative to said one direction such that the elastic bands are applied to the material in a curved contour, and feeding

the elastic bands while maintaining a selected side-to-side spacing between individual elastic bands throughout a range of feeder head and conveyor speeds.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a top plan view of a machine for applying leg elastic to garment material according to an embodiment of the present invention, having portions broken away to reveal underlying structure.

FIG. 2 is a side view of the embodiment of FIG. 1.

FIG. 3 is an enlarged partial top plan view of the embodiment of FIG. 1, with the addition of an elastic band tensioning device in accordance with one embodiment of the present invention.

FIG. 4 is an enlarged perspective view of the top of the feeder head of the embodiment shown in FIG. 1.

FIG. 5 is an enlarged view taken along line 5--5 in FIG. 4.

FIG. 6 is an enlarged perspective view showing the bottom of the feeder head of the embodiment shown in FIG. 1.

FIG. 7 is an enlarged bottom view of the feeder head of the embodiment shown in FIG. 1.

FIG. 8 is an enlarged partial elevational view showing the feeder and one gripper of FIG. 1.

FIG. 9 is an enlarged perspective view showing the gripper of FIG. 8.

FIG. 10 is an enlarged view of a portion of the gripper of FIG. 8, showing a cam extending a gripper spring.

FIG. 11 is an enlarged exploded perspective view of another form of feeder head according to an embodiment of the present invention.

FIG. 12 is a top plan view of the feeder head shown in FIG. 11.

FIG. 13 is a side elevational view of the feeder head shown in FIG. 11.

FIG. 14 is an enlarged end view of elastic grippers in accordance with an embodiment of the present invention, with the drum conveyor on which the grippers are mounted shown cut-away.

FIG. 15 is a side view of one elastic gripper shown in FIG. 14.

FIG. 16 is a cut-away top plan view of a machine for applying leg elastic to garment material according to an alternate embodiment of the present invention, showing a portion of the machine on one side of the longitudinal center line of the machine.

FIG. 17 is an enlarged top view of the feeder head of the embodiment shown in FIG. 16.

FIG. 18 is a cut-away top plan view of a machine for applying leg elastic to garment material according to yet another alternate embodiment of the present invention, showing a portion of the machine on one side of the longitudinal center line of the machine.

FIG. 19 is an enlarged elevational view of the feeder head and leading positioning fingers of FIG. 18.

FIG. 20 is an enlarged view taken along line 20--20 in FIG. 18.

FIG. 21 is a top plan view of the elastic gripper and cam shown in FIG. 20.

FIG. 22 is a cut-away top plan view of a machine for applying leg elastic to garment material according to another alternate embodiment of the present invention, showing a portion of the machine on one side of the longitudinal center line of the machine.

FIG. 23 is a cut-away top plan view of a machine for applying leg elastic to garment material according to an additional alternate embodiment of the present invention, showing a portion of the machine on one side of the longitudinal center line of the machine.

FIG. 24 is an enlarged top view of the feeder head of the embodiment shown in FIG. 23.

FIG. 25 is a schematic top plan view of a machine for applying elastic to garment material according to an additional alternate embodiment of the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

Referring first to FIGS. 1 and 2, apparatus generally indicated at 10 is constructed according to a preferred embodiment of the invention. The apparatus illustrated is specifically adapted to produce disposable diapers or training pants, but it should be understood that it is not limited to such products.

As is known, disposable diapers and training pants generally include an outer, or backing, sheet of a liquid impervious material, onto which an absorbent pad is placed. A liquid pervious liner, or inner, sheet is placed thereon to encase the absorbent pad therebetween. One garment and method of manufacture is illustrated in U.S. Patent No. 4,726,807 to Young and Lancaster, which is herein incorporated by reference to illustrate typical materials used and known methods of manufacturing such garments.

In the manufacture of such products it is often desirable to provide contoured strands, or bands, of elastic material extending generally longitudinally between the backing and liner sheets to produce elasticized leg opening areas for the garment produced. Since such products often are manufactured on assembly lines in which the garments material moves substantially continuously longitudinally, in what is referred to as the "machine direction," the elastic is placed on a moving web with the elastic stretched and extending generally longitudinally along the machine direction.

Referring to FIGS. 1 and 2, an elongate sheet, or web, of backing material 14 having a selected width is moved in one direction along a flow path 16 which extends in the machine direction. As is seen in FIG. 2, an elongate absorbent pad 15 is placed on backing material 14, and an elongate sheet of inner liner material 17 is laid thereover.

For example, the liquid impervious back sheet 14 may be of a thin thermoplastic material, such as a pigmented polyethylene film having a thickness in the range of 0.02-0.04 mm.

The liquid pervious liner sheet 17 may be a carded polyester fiber with a latex binder or a spun-bonded polypropylene having continuous fibers and thermally bonded by patterned calendar rolls. The liner sheet may be impregnated with a surfactant to render it hydrophilic. The absorbent pad 15 may be of wood fibers or other fibers, such as chemical wood pulp, or any other suitable moisture absorbing material such as commercially available fluff pulp or a fluffed bleached craft soft wood pump.

First and second sets of elongate elastic elements 20, 22, each set herein shown as including individual elastic bands 20a, 20b, 20c, and 22a, 22b, 22c, respectively, extend generally longitudinally along the flow path 16 and are adhered to the backing material 14. The first and second sets of bands 20, 22 are arranged in a symmetric, curved contour, or pattern 21 that generally resembles a repeating hour-glass pattern, with inboard regions 25, diagonal regions 26, and outboard regions 27. A contoured dashed line 19 positioned along the sets of bands 20, 22 indicate leg contour cut-out lines at which leg openings will be severed from the garment in the manufacturing process. The sets of bands 20, 22 will elasticize the leg opening regions of the garments produced.

Describing the apparatus, and referring still to FIGS. 1 and 2, a circular conveyer drum 28 is supported on and driven about a central axle 29. The direction of rotation is indicated generally by arrow 29a. The peripheral face 30 of the drum supports backing material 14 as it travels from the bottom side of the drum to the top side of the drum in FIG. 1. The drum is wider than the usual width of material to be carried thereon so that it can accommodate sheet material of different widths.

An adhesive applicator for applying adhesive to the side of the backing material sheet 14 that receives the elastic is generally indicated at 31. The adhesive applicator 31 preferably sprays adhesive onto the backing material upstream of the conveyor drum 28 to prevent accumulation of any possible overspray on the conveyor drum 28. The adhesive may be applied over the entire outward width of the backing material sheet 14 to provide adhesion for the sets of bands 20, 22 and pads 15.

A first nip roller 32a is mounted above the conveyor drum 28 for rotation about an axle 36a substantially parallel to drum axle 29. The first nip roller counter-rotates relative to the conveyor drum in the direction indicated by arrow 33a and presses against drum 28 at a first nip 34a. The first nip roller 32a tightly presses the backing material 14 and the liner material 17 over the sets of bands 20, 22 between the drum 28 and the first nip roller 32a at first nip 34a.

A pad conveyor 37 is operable to carry longitudinally spaced pads 15 and insert them at the first nip 34a such that pads are captured between the backing and liner sheets 14, 17.

A second nip roller 32b is mounted above the conveyor drum 28 downstream from the first nip roller 32a. The second nip roller is driven for rotation about an axle 36b substantially parallel to drum axle 29. The second nip roller counter-rotates relative to the conveyor drum in the direction indicated by arrow 33b and presses against drum 28 at a second nip 34b.

The combined backing and liner sheet with an absorbent pad encased therebetween are carried downstream, to the right in FIGS. 1 and 2, and are supported on subsequent rollers 38a, 38b (FIG. 2) and other conveyor mechanism in the system as they are moved therealong.

Referring now more specifically to the apparatus for applying the sets of elastic bands 20, 22 and referring to FIG. 2, an elastic storage container is generally indicated at 39. An elongate strip of elastic material 39b is drawn from container 39 and carried in the direction of arrow 40. The elastic strip material already has been scored during its manufacture such that it is easily split into two sets 20, 22 of three elastic bands each 20a, 20b, 20c, and 22a, 22b, 22c.

An example of the elastic used is 0.015 inch by 0.027 inch, three-strand natural rubber obtained from Fulflex. However, the elastic may be any form of elasticized material which may be found to be desirable for producing the product at hand. Examples of other materials which might be used are polyurethane, ribbon elastic, lycra strands, or others used in the industry.

A splitter device which produces this function and also provides initial tensioning of the strands is indicated generally at 41. This splitter device includes a first pair of powered counter-rotating rollers 42a between which the elastic strip 39b is moved. A second set of powered counter-rotating rollers 42b are positioned downstream from rollers 42a with the elastic bands moving between the rollers 42b. Rollers 42b are driven at a speed slightly higher than rollers 42a, such that the elastic band are stretched in tension. A plurality of spaced pins 43 are disposed between rollers 42a, 42b with the elastic bands being routed about the pins to separate the elastic strip 39b into six individual bands.

As shown in FIG. 1, an elastic feeder is positioned above the conveyor drum 28 and generally indicated at 44. An elongate support member 48 extends from a frame 46 laterally across a machine centerline 51 that extends along the center of the drum face 30 at the center of flow path 16.

A reciprocating belt 50 is trained about a pair of pulleys 52 which are rotatably mounted on the support member 48. The pulleys 52 are positioned adjacent opposing sides of the flow path such that the belt 50 extends laterally across the flow path. The belt thus has a first linear belt portion 51a positioned downstream of the pulleys and a second linear belt portion 51b positioned upstream of the pulleys. As the belt is moved about the pulleys 52, the first and second linear belt portions 51a, 51b move in opposing directions transversely of the flow path 16.

First and second feeder heads 53a, 53b are mounted on the belt for simultaneous, symmetric, reciprocative movement along a linear path 54 extending transversely of the flow path. To provide for this symmetric reciprocative motion, the first feeder head 53a is fixedly mounted to the first linear belt portion 51a at bracket 55a, and the second feeder head 53b is fixedly mounted to the second linear belt portion 51b at bracket 55b. The brackets 55a, 55b respectively include elongate extension members 56a, 56b that extend beneath the belt 50. The feeder heads mount to the downstream ends of the extension members, and vertical guide flanges 68a, 68b extend

upwardly from the upstream ends of the extension members. The guide flanges 68a, 68b are slidably held within a grooved guide member 69 which extends parallel to the linear path 54.

Thus, when the belt 50 is moved, the first and second feeder heads 53a, 53b move in opposing directions. The sets of elastic bands 20, 22 are guided through the respective feeder heads 53a, 53b. Applying the sets of elastic bands 20, 22 from the reciprocating feeder heads directly to the moving sheet of backing material 14 produces the symmetric curved elastic "hour glass" contour 21.

Although the sets of bands 20, 22, shown in FIG. 1 are covered with liner material 17, they are shown in solid lines for clarity. The first nip roller 32a has a relatively small diameter which is preferably about two inches. The small first nip roller diameter permits the feeder heads 53a, 53b to be positioned very close to the first nip 34a to minimize "dragging" of the elastic bands as the feeder heads reciprocate along the linear path 54. In other words, the short span of the elastic bands from the feeder heads to the first nip 34a permits precise application of the bands onto the materials 14, 17.

As will be appreciated by attention to FIG. 1, the shape of the elastic contour 21 is related to the ratio of the rate of lateral motion of the feeder head across the flow path 16 (feeder rate) and the rate of motion of the conveyor drum face 30 in the flow path direction 16 (conveyor rate). In general, the elastic is applied at a maximum angle relative to the flow path 16 when the feeder rate is at its maximum speed. Accordingly, the maximum feeder rate corresponds to the contour diagonal portion 26. Conversely, the elastic is applied parallel with the flow path when the feeder rate is zero, meaning the feeder head 53 is stationary. Mathematically expressed, the elastic bands of the diagonal region 26 extend relative to the flow path 16 at an angle = arctan (feeder rate ÷ conveyor rate).

The belt 50 is driven by a cam device 57. The device includes a cam mounting plate 57a that is mounted on the frame 46 and supports a horizontally rotating cam 58. The cam device 57 may be driven by a belt 62 and pulley 63a, 63b mechanism. A cam pulley 63a is mounted on cam shaft 63c beneath the cam 58 in planar registration with a drive pulley 63b that is mounted on a powered drive shaft 65. The belt 62 is trained about the pulleys 63a, 63b to drive the cam 58.

The shape of the curved elastic contour 21 is varied by varying the shape of the cam 58. In the preferred embodiment, the cam is shaped in a 6th order polynomial curve to obtain the complex curved contour 21 shown in FIG. 1. (For illustrative purposes, cam 58 is shown with a simple circular shape.) The preferred elastic contour 21 yields garments with leg elastic having varying selected curvature from front to rear about the garment leg openings. Thus, any of a variety of elastic curves that are effective in retaining moisture may be produced through application of the cam mechanism. If a simple smooth curved contour is desired, an eccentrically mounted circular cam could be used, or the belt could be otherwise driven in a simple reciprocating fashion.

A connecting rod 64 extends from the cam device 57 to reciprocatively drive the belt 50. The connecting rod 64 extends from a proximal pivot attachment 66a on the cam 58 to a distal pivot attachment 66b on a belt drive bracket 67 mounted to the second linear belt portion 51b. Cam rotation reciprocates the belt to reciprocate the feeder heads 53a, 53b symmetrically along the linear path 54.

In another aspect of the present invention, the tension in the elastic bands may be maintained at a substantially constant preferred level where the bands are applied to the first nip 34a. Maintaining a constant preferred level of tension avoids the tendency of the elastic bands to "bunch" together when the bands are applied in sharp curves on the material 14. Such bunching tends to occur due to excess variation in tension due to varying elastic band accelerations generated by the moving feeder heads in applying the bands in sharp curves.

In order to provide for constant tension at the point of application of the elastic bands, a tensioning device may be provided along the elastic bands just upstream of the feeder heads 53a, 53b. Such a tensioning device varies the tension in the bands feeding into the feeder heads in order to counteract the variance in tension generated by the acceleration of the feeder heads in applying the curved elastic contours.

A variety of tensioning devices will work for producing the desired constant elastic tension at application. For example, FIG. 2 shows a tensioning device 70 with a plurality of lower rollers 71a and upper rollers 71b through which the elastic bands are guided. The upper rollers 71b are movable as shown in FIG. 2 to vary the tension in the elastic bands passing therethrough. The upper roller movement may be controlled through a linkage 72a which is reciprocated by a cam 72b. Instead of cam 72b, the linkage 72a could be linked to cam 58 shown in FIG. 1 to appropriately control the upper roller movement.

The cam-controlled roller movement is correlated with the elastic tension generated by the movement of the feeder heads 53a, 53b along the linear path 54. For instance, the upper rollers 71b may be moved toward the lower rollers 71a to decrease tension in the elastic when the feeder heads are accelerating along the linear path. Conversely, the upper rollers 71b may be moved away from the lower rollers 71a to increase the elastic tension when the feeder heads are stationary at either end of the linear path 54. The tensioning device 70 is most effective when it is positioned as close as possible to the feeder heads 53a, 53b.

FIG. 3 shows another embodiment of a tensioning device 70b, which includes a belt 50b positioned over belt 50. Belt 50 is illustrated in FIG. 1 and is covered by belt 50b in FIG. 3. Elastic band guides 73a, 73b are mounted to belt 50b much like feeder heads 53a, 53b are mounted to belt 50. The elastic bands 20a, 20b, 20c are guided through the band guides 73a, 73b just upstream of the feeder heads 53a, 53b. Belt 50a is also reciprocatively driven (through cam 58 and connecting rod 64b) much like belt 50.

In the embodiment of FIG. 3, the belt 50b is linked to cam 58 so that the elastic guides 73a, 73b are reciprocated to maintain a generally constant tension in the elastic bands being

fed from the feeder heads 53a, 53b. For example, in the illustrated case where the feeder heads are stationary at the ends of the linear path 54 (i.e. band acceleration and tension are low), the elastic band guides 73a, 73b accelerate the bands inward along the linear path to provide a preferred level of tension in the bands. When feeder heads 73a, 73b are at maximum acceleration through the linear path 54 (i.e. the accelerated bands have a preferred level of tension), the band guides are at rest so not to add any tension to the preferred level.

While the belt 50b is shown linked to cam 58, it is to be understood that another cam may be provided to produce desirable band guide motion. It is also understood that in addition to linear motion, the band guide motion may be elliptical, circular, or of other shapes.

Preferred Embodiment

As shown in FIG. 1, the feeder heads 53a, 53b extend fixedly downward from the upstream ends of the respective bracket extension members 56a, 56b.

The feeder head 53a of FIGS. 1 and 2 is shown enlarged in FIGS. 4-7. The feeder head 53a is adapted to apply three elastic bands 20a, 20b, 20c with a constant, equi-distant spacing between adjacent elastic bands, throughout the curved elastic contour 21.

As shown in FIGS. 4-7, this embodiment has a feeder head 53a that applies three elastic bands 20a, 20b, 20c from three platforms 74a, 74b, 74c having different elevational levels. The top of the feeder head 53a has a pair of threaded apertures 75 for attachment to the extension members by threaded fasteners. The elastic bands 20a, 20b, 20c are fed generally vertically into the feeder head 53a. The elastic bands 20a, 20b 20c are guided through band grooves 78a, 78b, 78c defined vertically through the back of feeder head 53a. The elastic bands 20a and 20c represent first and second outermost elastic bands applied by the feeder head 53a, and band 20b represents a central band applied by the feeder head.

The feeder head has first and second arcuate surfaces 80a, 80c from which the respective first and second outermost elastic bands 20a, 20c are guided from the feeder head. The arcuate wall portions define a single arc about a vertical central feeder head axis 79 with a diameter that sets the spacing between the outermost bands 20a, 20c. A central guide aperture 81 for the central band 20b is defined in the feeder head coaxial with the central axis 79.

As best shown in FIG. 7, the bands 20a, 20b, 20c are fed from the feeder head 53a with a fixed spacing between the central band 20b and the both of the outermost bands 20a, 20c, throughout a range of band feed angles. The outermost bands 20a, 20c extend tangentially from tangent (or "guide") points 81a, 81c on the first and second arcuate surfaces 80a, 80c. When the bands are fed from the feeder head at varying angles (such as occurs when the feeder head 53a reciprocates along the flow path 54) the guide points 81a, 81c are automatically repositioned along the arcuate surfaces 80a, 80c to maintain a fixed perpendicular spacing between the bands 20a, 20c equal to the feeder head arc diameter. Furthermore, the fixed central guide aperture 81a always

remains mid-way between and co-linear with the tangent points 81a, 81c, so that the spacing between all of the individual bands remains constant.

The solid line and dashed line depictions of outermost bands 20a and 20c show the range of movement of the tangent points 81a and 81c on the arcuate surfaces 80a, 80c as the bands are guided from the feeder head at different angles. The automatic repositioning of the tangent points maintains the constant spacing between the central band 20b and both of the outermost bands 20a and 20c throughout a range of feeder head and conveyor speeds.

As best illustrated in FIGS. 1 and 8, the feeder head 53b applies the elastic bands from the three offset platforms to cooperate with an elastic gripper 88. As shown in FIG. 1, outboard extending elastic regions 27g are gripped in tension by grippers 88, which are mounted at intervals along the opposing outboard edges of the conveyor drum face 32. The width of the material sheets 14, 17 is selected such that the material is positioned between the grippers 88. The nip rollers 32a, 32b are longitudinally somewhat shorter than the drum conveyer 28, so that the nip rollers rotate between the opposing grippers 88.

The grippers are adapted to hold the elastic bands 20a, 20b, 20c of the outboard contour region 27 in tension outboard of the material. The feeder heads 53a, 53b sweep laterally to an outboard position adjacent the grippers 88 such that the elastic bands 20 are applied outboard of the material 14, 17, nip rollers 32a, 32b, and gripper 88. As shown in FIG. 9, the elastic bands 20 applied outboard of the grippers 88 and nip rollers are not pinched at the nip 34a and thus contract inward into engagement with the gripper 88.

The gripper 88 engages the elastic bands 20a, 20b, 20c when the feeder head 53a is moved adjacent the gripper at the outboard end of the linear path 54. As best shown in FIGS. 9 and 10, the gripper 88 comprises an elongate coil spring 90 that receives the bands 20a, 20b, 20c between its coils. The spring is radially mounted on the drum and is extendable by an L-shaped extension rod 94. The vertical portion of the rod 94 extends axially through the coil spring and is fixed to the spring top by a fitment 97. The spring coils abut tightly against one another when the spring is not extended. The lateral portion 95 of the L-shaped rod 94 is positioned to engage the ramped upper surface of a fixed cam 92, which acts to extend spring 90, thereby producing openings between adjacent spring coils that act as holding bays to receive the elastic bands 20a, 20b, 20c at different levels.

As shown in FIG. 9, the cam 92 is fixedly positioned adjacent and upstream of the first nip 34a to extend the spring before the feeder head 53a moves outside the gripper. As the gripper 88 moves by the feeder head 53b, the cam releases the rod 94 to permit retraction of the coil spring, thereby gripping the bands between the coils.

As shown in FIGS. 8 and 9, a trailing row of positioning fingers 98a, 98b, 98c are fixed along the length of the edge of the conveyor face 32 to receive the elastic bands 20a, 20b, 20c. The fingers may be screws with heads to retain the individual elastic bands. The leading screw 98a has a relatively high head elevation to receive the highest elevation elastic band 20a, the

intermediate screw 98b has an intermediate head level to receive intermediate band 20b, and the trailing screw 98c has a relatively low head level to receive lowest band 20c. The positioning of the screws 98a, 98b, 98c guides the bands 20a, 20b, 20c through the trailing diagonal contour portion 26 with the selected spacing between the bands.

The elastic bands 20a, 20b, 20c gripped by the grippers 88 extend outwardly in tension from opposing edges of the overlaid sheets 14, 17 of garment material. A stationary cutting blade 100 positioned downstream of the first nip 34a at opposite sides of the drum severs outboard portions of the backing and liner materials and the leading bands held by the coil spring 90 adjacent the overlaid sheets. The trailing elastic bands are held in tension by the retracted coil spring 90 until severed by blade 100.

The grippers 88 release the severed lengths of elastic adjacent the bottom side of the drum 28. Stationary release cams 102 are positioned adjacent each side of a lower portion of the drum to extend the coil springs 90 so that the severed portions of the elastic bands fall from the springs 90 as scrap.

Since the outboard elastic contour region 27 is scrapped in this embodiment, a garment is formed with elastic bands 20a, 20b, 20c extending about the leg openings, but not fully up the sides of the garment.

<u>Alternate Embodiment No. 1</u>

An alternative feeder head 53 is shown in FIGS. 11-13. The feeder head 53 is cylindrical and guides bands 20a, 20b, 20c while maintaining a constant spacing between the bands. A diagonal slot 82 in the bracket extension member 56 guides the elastic bands 20a, 20b, 20c to the feeder head 53. The slot 82 is cut into the inboard portion of the bracket extension member adjacent the feeder head 53 and extends rearward (opposite the flow path 16) to the longitudinal center of the bracket member 56.

The three bands 20a, 20b, 20c are guided from above through the diagonal slot 82 to the feeder head. A central band 20b is guided through a central slot 84 in the feeder head 53. The central slot 84 extends diagonally from the top edge of the feeder head to the center of the bottom surface 85 of the feeder head 53. The top of the central slot 84 is positioned adjacent the terminus of the diagonal slot 82 at the bracket member centerline. The central band 20b extends through the central slot 84 for constant application from the center of the feeder head bottom.

The outermost elastic bands 20a, 20c are guided through a pair of opposing, L-shaped guides 86a, 86b around the circular periphery of the feeder head 53. The L-shaped guides 86a, 86b extend horizontally from a rear portion of the cylindrical feeder head 53. Each L-shaped guide 86a, 86b has a distal leg directed inwardly toward the opposite L-shaped guide. The guides 86a, 86b are closely spaced such that the outer elastic bands 20a, 20c are constantly applied tangentially from the cylindrical feeder head 53. The feeder head has a diameter equal to the selected spacing between the outermost individual elastic bands 20a, 20c.

The constant application of the central elastic band 20b from the center of the cylindrical feeder head 53, and the constant application of the outermost elastic bands 20a, 20c tangentially from the periphery of the feeder head 53 (i.e., from automatically repositionable guide points on the feeder head periphery), yield a constant equi-distant perpendicular spacing between adjacent bands 20a, 20b, 20c throughout the curved elastic contour 21.

In another aspect of the alternative embodiment, illustrated in FIGS. 14 and 15, alternative elastic grippers 188 are fixed at intervals along the opposing outboard edges of the conveyer drum face 32.

The gripper 188 is elongate and has a longitudinal slot 190, or holding bay, in the outboard face 191 that receives the contracting elastic bands 20. A locking pin 192 having a notch 196 extends through a bore 193 in the gripper and is actuable to grip the elastic bands 20 within the slot 190. The pin 192 is mounted upon a coil spring 194 to normally bias the pin upwardly to a lock position. In the lock position, the pin notch 196 moves into an upper portion of the bore 193, and the top 197 of the pin 192 protrudes from the top of the gripper 188.

To receive the elastic bands 20a, 20b, 20c, a stationary cam 198 depresses the locking pin top 197 such that the pin notch 196 moves downwardly into alignment with the slot 190. The cam 198 is fixed adjacent the first nip 34a to depress the locking pin 192 as the elastic is applied outboard of the gripper 188. The cam 198 releases the pin 192 downstream of the first nip 34a to return the pin 192 to the lock position wherein the elastic is gripped between the bottom of the notch 196 and the top of the longitudinal slot 190.

Alternate Embodiment No. 2

FIGS. 16 shows a machine embodiment with a pivotal feeder head 53c that permits selected spacing between a plurality of individual elastic bands. In this case, the feeder head is adapted to apply four bands 20a, 20b, 20c, 20d.

As best shown in FIG. 17, the feeder head 53c is pivotally attached to the distal end of the bracket extension member 56c. The feeder head 53c is block-shaped, with four elastic outlet apertures 104 for applying the four elastic bands. The apertures 104 extend vertically through the head in a fixed spatial relation to one another, and are aligned in an aperture line 107 extending across the bottom surface of the head 53d. The elastic bands 20a-20d are guided through the top of the apertures 104 and exit the bottom of the apertures along the aperture line 107.

The feeder head 53c pivots about a vertical pivot pin 108 at the distal end of the extension member 56c. The distal end of the extension member has an enlarged orientation surface 110 extending perpendicular to the length of the extension member. A biasing means, such as a torsion spring 112, biases the feeder head 53c against the orientation surface 110 to normally orient the aperture line 107 substantially perpendicular to the length of the extension member 56c. The torsion spring 112 has a coiled portion 114 that is centered about the pivot pin 108. First and second lever arms 116, 118 extend from opposite ends of the coil 114.

The first lever arm 116 is held static by an anchor pin 120 extending from the top of the extension member. The second lever arm 118 engages the feeder head 53c to pivotally bias it against the orientation surface 110.

A cam 105 is positioned adjacent the inboard portion of the linear path 54c to selectively pivot the feeder head. The cam 105 has a curved cam face 122 that is engaged by a roller 124 on the inboard downstream corner of the feeder head 53c. The elastic bands 20a-20d extend from the aperture line 107 beneath the cam 105 for application adjacent the first nip 34a.

As best appreciated by referring to FIG. 16, the selected pivoting of feeder head 53c, and thus the contour of the cam face 122, is related to the foregoing discussion of the ratio of the feeder rate and conveyor rate. With this relationship in mind, the application of the elastic contour regions 25c, 26c, 27c will now be described.

The diagonal elastic portion 26c is applied when the aperture line 107 is substantially perpendicular to the flow path 16c. Since the bands 20a, 20b, 20c, 20d extend diagonally from the aperture line 107, the perpendicular spacing between the elastic bands of the diagonal portion 26c is narrower than the spacing between the apertures 104. The spacing becomes narrower as the angle (designated by arrow 125) between the contour diagonal portion 26c and the flow axis 16c increases. Expressed mathematically, the spacing between the individual elastic bands 20a—20d = (spacing between outlet apertures 104) x cos (angle 125).

The feeder rate momentarily becomes zero at each end of the linear path 54c. At the outboard end of the linear path 54c where the outboard elastic region 27c is applied, the elastic bands are fed perpendicular from the aperture line 107 and thus have a relatively wide spacing between individual bands.

At the inboard end of the linear path where the inboard elastic region 25c is applied, the cam 105 pivots the feeder head 53c to avoid the relatively wide spacing of the outboard region 27c. The cam 105 pivots the feeder head 53c so that the elastic bands exit from the outlet line 107 at an angle generally equal to the angle of the diagonal region 26c relative to the flow axis 16c. Therefore, the spacing between the elastic bands 20 of the inboard region 25c and diagonal region 26c is substantially equal.

In order to maintain the equal spacing, the cam 105 gradually pivots the feeder head 53c as the feeder rate decreases near the inboard end of the linear path 54c. Expressed mathematically, the aperture line 107 pivots by an angle = arctan ((maximum feed rate - feed rate) ÷ (conveyor rate)). Thus, at the inboard end of the linear path 54c where the feed rate is equal to zero, the aperture line 107 is pivoted at an angle = arctan (maximum feed rate ÷ conveyor rate).

In another aspect of this embodiment, the entire elastic contour 21c is encased between the overlaid backing sheet 14c and liner sheets 17c. To encase the entire elastic contour, the drum 28c and nip roller 32c are as least as long as the width of the material 14, 17. No grippers are required.

An outboard margin portion 129 of the backing and liner sheets, including the encased relatively wide-spaced bands of the outboard elastic region 27c, is trimmed away as waste. A cutting blade 130 is fixedly positioned for this purpose downstream of the nip roller 32c. Thus, a garment is formed with elastic bands 20a-20d extending about the leg openings, but not completely up the garment sides.

Alternate Embodiment No. 3

FIGS. 18—21 show another alternative embodiment with a cam 105d and pivotable feeder head 53d similar to those shown in FIGS. 8 and 9. The feeder head 53d is pivoted by a cam 105d at the inboard end of the linear path 54d to maintain constant spacing between elastic bands at the inboard 25d and diagonal 26d contour portions.

As shown in FIG. 18, however, the outboard contour regions 27d extend laterally outboard of the edge of the material sheets 14d, 17d. The outboard extending elastic regions 27d are gripped in tension by elastic grippers 88d. The grippers 88d are mounted at intervals on a second conveyor 132 to receive the bands of each outboard elastic region 27d. The second conveyor 132 runs parallel to one side of the flow path 16d at a speed equal to the conveyor speed. The conveyor 132 may run about a pair of powered spaced rollers 135.

The feeder head 53d moves adjacent the gripper 88d when at the outboard end of the linear path 54d. When so positioned, the feeder head 53d applies the bands 20a, 20b, 20c, 20d to the gripper 88d.

The gripper first receives the bands between a plurality of vertical positioning fingers 134a that extend in a row transversely across the second conveyor 132. As shown in FIG. 19, the bottom surface of the feeder head 53d has a plurality of protruding feeder fingers 136 through which the outlet apertures 104d extend. The moving positioning fingers 134a interdigitate with the feeder fingers 136 such that the elastic bands 20a, 20b, 20c, 20d are fed between the positioning fingers 134a.

The tension in the elastic bands 20 causes the bands to move into position against the positioning fingers 134a. The fingers have substantially inverted conical shapes that securely urge the elastic bands 20a, 20b, 20c, 20d downwardly toward the second conveyor 132.

As the second conveyor continues and the feeder head 53d remains at the outboard stationary position, the bands 20a, 20b, 20c, 20d are further threaded through the gripper 88d. As shown in FIGS. 20 and 21, the gripper 88d includes a pair of gripper plates 138 that sandwich a slidable spring-biased locking plate 140 therebetween. A pin 148 fixed in both gripper plates 138 extends through an elongate slot 150 in the locking plate to interconnect the plates 138, 140.

The gripper plates and locking plate, respectively, have a plurality of upwardly oriented gripper fingers 142, and locking fingers 144. The locking plate 140 is ordinarily biased by the spring 139 to offset the gripper and locking fingers 142, 144 in a lock position (FIG. 20).

The locking plate 140 has a roller 145 that is engagable by a stationary cam 146 to slide the locking plate to an open position. As shown in FIG. 21, the gripper and locking fingers

142, 144 are aligned to interdigitate with the feeder fingers 136 in the open position. In this fashion, the feed head positions the bands 20a, 20b, 20c, 20d between the open fingers 142, 144 of the gripper 88d.

As the gripper 88d moves past the feeder head 53d, the cam 146 releases the locking plate to return the gripper 88d to the lock position wherein the bands are gripped between the offset fingers 142, 144 (FIG. 20).

A trailing row of positioning fingers 134b, similar to fingers 134a, next interdigitate with the feeder fingers 136 to position the trailing bands of the outboard contour region 27d. The feeder head 53d then swings inboard to apply the diagonal elastic region 26d. As best illustrated in FIG. 18, the leading and trailing fingers 134a, 134b position the elastic bands such that the diagonal contour region 26d relative to the flow axis 16d is at a selected angle.

As shown in FIG. 18, the outboard elastic region 27d gripped by the gripper 88d is severed at the edge of the assembled material sheets 14d, 17d. A stationary cutting blade 130d is positioned downstream from the roller 32d to first sever the leading bands of the outboard contour 27d. The trailing bands of the outboard contour region 27d remain held in tension by the gripper 88d until severed by cutter 130d.

Alternate Embodiment No. 4

The embodiment shown in FIG. 22 has a pair of cams 105e, 152e positioned at both ends of the feeder head linear path 54e to provide constant spacing between the individual elastic bands 20 throughout the inboard, diagonal, and outboard elastic regions 25e, 26e, 27e.

Cam 105e is positioned adjacent the inboard end of linear path 54e to pivot the feeder head 53e as described in the alternate embodiment of FIGS. 16 and 17. As shown in FIG. 22, opposing cam 152e is positioned adjacent the outboard end of linear path 54e to similarly pivot the feeder head 53e as the bands 20a, 20b, 20c, 20d of the outboard elastic region 27e are applied.

The feeder head 53e has rollers 124e at both ends for engaging the opposing cams 105e, 152e.

Feeder head 53e is somewhat similar to feeder head 53c of FIGS. 16 and 17. However, feeder head 53e must be able to pivot on both sides of the distal end of extension member 56e. Thus, the extension member does not have an enlarged distal orientation surface.

Feeder head 53e may be provided with resilient biasing means to normally urge the feeder head into a perpendicular position at the distal end of extension member. Alternatively, the opposing cams 105e, 152e may be extended to abut and form a unitary cam surface. Such a unitary cam may continuously position the feeder head if both rollers 124e continuously engage unitary cam surface, in which case no biasing means is needed.

The material sheets 14e, 17e have a selected width to encase the entire elastic contour 21e. Thus, there is no need for scrapping a margin portion of the material. In this way, a

garment is produced with an elastic contour 21e having constant perpendicular spacing between the bands 20a-20d, and extending completely up the sides of the garment.

Alternate Embodiment No. 5

The embodiment shown in FIGS. 23 and 24 has a feeder head 53f that is freely pivotable about a vertical pivot shaft 108f at the distal end of the extension member 56f.

The feeder head 53f is freely pivoted by the tension of the elastic bands 20a, 20b, 20c, 20d held at the nip 34f, as the feeder head 53f moves laterally across the flow path (FIG. 23). The pivoting is such that the elastic bands 20 generally always extend perpendicular to the aperture line 107f. In other words, the elastic band apertures 104f (guide points) are automatically repositionable to maintain a constant perpendicular spacing between individual elastic bands.

Thus, in a machine environment without grippers 88, 188, 88d, the applied elastic bands 20a, 20b, 20c, 20d always have a spacing equal to the spacing between the outlet apertures 104f. In such an embodiment, band spacing remains constant throughout the inboard 25f, diagonal 26f, and outboard contour regions 27f. Mathematically expressed, the aperture line 107f is pivoted to an angle relative to the flow path 16f = arctan (feeder rate ÷ conveyor rate).

FIG. 23 shows materials 14f, 17f having a selected width to completely encase all regions 25f, 26f, 27f of the elastic contour. While no trimming of an material edge margin is shown, such trimming may be undertaken if desired.

Alternate Embodiment No. 6

FIG. 25 schematically shows another machine embodiment 10g according to the present invention. Two head drive belts 50g, 51g (similar to belt 50 previously described) are used to apply the sets of elastic bands 20, 22 in different (i.e. non-symmetric) curved contours. Such non-symmetric contours may be desirable with training pants that are conveyed through the machine with opposed waist regions 11g, 11h disposed parallel to the flow path 16. Two cams 58g, 59g (similar to cam 58 previously described) are provided so that each belt is driven to produce a different curved contour. In FIG. 25, cam 58g moves belt 50g through a relatively short stroke in order that feeder head 53g reciprocates along a relatively short linear path to produce a relatively shallow curved contour 22g. Cam 59g moves belt 51g through a relatively long stroke in order that feeder head 54g reciprocates along a relatively long linear path to produce a relatively deep curved contour 23g. The shallow contour may advantageously be positioned on the front side of a diaper or training pant for excellent fit and comfort.

The above embodiments describe particular combinations of feeder heads 53, 53a, 53b, 53c, 53d, 53e, 53f, grippers 88, 188, 88d, and edge margin portion trimming. It is to be understood that other combinations of particular feeder heads, grippers, and margin trimming treatments may work equally as well.

For instance, the grippers 88, 188 are not necessary for the use of any particular feeder head. If feeder head 53 is used without the gripper 88 and with material and a nip roller of

sufficient width, a garment may be produced encasing the entire curved elastic contour and having constant spacing between the elastic bands throughout the entire curved contour. If no cutter is used, the elastic contour will extend fully up the sides of the finished garment. If a garment edge margin is trimmed away, the elastic contour will only extend along the leg openings in the finished garment.

Moreover, it is to be understood that excellent results under this invention may be produced without the tensioning devices 70, 70b. For instance, short elastic band span distances between the feeder heads and the first nip are effective in maintaining equal spacing between individual elastic bands.

Preferred Method

In a preferred method for applying elastic to garment material according to the invention, garment backing material 14 is moved in one direction along the flow path 16, which includes movement from bottom to top about drum 28. Prior to reaching the drum, adhesive is applied to the side of the backing material facing outward from the drum 28.

A source 39 of a plurality of elongate elastic bands 39b is provided that are guided onto the material in first and second sets, each set including a plurality, of bands 20, 22. The first and second band sets are guided from first and second positions moving symmetrically and linearly transverse across the backing material relative to the flow path direction such that the first and second sets of elastic bands are deposited on the material in a pair of symmetric curved contours 21.

The elastic bands are deposited on and encased between the backing and liner materials adjacent the first nip 34a of the drum 24 and a counter-rotating first nip roller 32a. The bands may be held in tension as they are so deposited. The encasement step includes tightly pinching the sets of bands between the first nip roller and drum.

A selected spacing may be maintained between individual elastic bands in the first and second sets of bands 20, 22 throughout the curved contour. To provide such spacing, the individual elastic bands of the first and second sets may be guided onto the material from guide points, such as those established by the arcuate surfaces of the feeder head 53a, 53b and 53. The guide points may also be outlet apertures 104 arranged along line 107 in the feeder heads 53c, 53d, 53e, 53f. The line is pivoted relative to the one direction during the lateral movement of the first and second positions.

The line may be freely pivoted by the tension in the elastic bands (FIGS. 23 and 24). Alternatively, the line may be normally biased toward a particular position, and a cam used to selectively pivot the line away from the particular position (FIGS. 16, 17, 18, and 22).

Furthermore, as shown in FIGS. 4-7 and 11-13, a selected spacing between the outermost bands 20a, 20c in a set may be accomplished by guiding those bands about the periphery of a feeder head 53a, 53 with a selected side-to-side dimension. Three elastic bands

20a, 20b, 20c may be deposited with constant equidistant spacing between each band where the intermediate band 20b is guided through the center of the feeder head.

The method may also comprise providing material with a defined width such that the curved contour formed by the first and second sets of elastic bands extends at spaced intervals laterally outwardly beyond the edges of the material. The elastic bands so positioned outboard of the material may be gripped and held in tension prior to being severed adjacent the edge of the material.

Furthermore, the method may include the step of trimming a side margin portion of the overlaid backing and liner material.

While particular embodiments of the present invention have been illustrated and described herein, it should be obvious to those skilled in the art that variations and modifications are possible without departing from the spirit of the invention as set out in the appended claims.

CLAIMS

What is claimed is:

1. A machine for applying elastic to material, comprising:

a conveyor moving in one direction along a flow path and operable to carry material for garments;

an elastic band storage for providing a plurality of elongate elastic bands; and

an elastic feeder having a feeder head that moves across the flow path to feed the plurality of elastic bands onto the conveyor, the feeder head having guide points from which elastic bands are guided onto the conveyor, the guide points having positions that are automatically repositionable in response to feeder head and conveyor speeds such that the perpendicular spacing between the elastic bands fed from the feeder head remains substantially constant through a range of feeder head and conveyor speeds.

2. The machine according to claim 1, wherein the feeder head moves along a linear path perpendicular to the flow path.

3. The machine according to claim 2, wherein a first nip roller is positioned in rolling contact with the conveyer adjacent and parallel to the linear path, the rolling contact defining a first nip, and the elastic bands being fed from the feeder head onto the conveyor at the first nip.

4. The machine according to claim 3, wherein the first nip roller carries garment material which is deposited onto the conveyor and on top of the elastic bands carried on the conveyor at the first nip.

5. The machine according to claim 1, wherein a tensioning device is positioned upstream of the feeder head, the tensioning device operable to engage the elastic bands and generate varying tension in the bands correlated with varying movement of the feeder head relative to the conveyor.

6. The machine according to claim 1, wherein a tensioning device is positioned upstream of the feeder head, the tensioning device having movable tensioning members through which the plurality of elastic bands are guided, the movable tensioning members being movable to generate selected varying tension in the elastic bands guided into the feeder head in correlation with varying movement of the feeder head relative to the conveyor.

7. The machine according to claim 2, wherein the first nip roller has a diameter of about two inches, and the linear path for the feeder head is closely spaced to the first nip roller.

8. A machine for applying elastic to material, comprising:

a conveyor moving in one direction along a flow path and operable to carry material for garments;

an elastic band storage for providing a plurality of elongate elastic bands; and

an elastic feeder having a first feeder head for feeding a plurality of elastic bands directly onto a first material carried by said conveyor, the feeder head being movable along a linear path extending transversely of the flow path whereby the elastic bands are applied to the first material on the conveyor in a curved contour, the feeder head being operable to feed the elastic bands onto the material while maintaining substantially constant selected perpendicular spacing between individual elastic bands throughout the curved contour.

9. A machine according to claim 8, wherein the feeder head is mounted on a movable belt, the belt being movable to move the feeder head along the linear path transversely of the flow path.

10. A machine according to claim 8, wherein the movable belt is trained about a pair of pulleys, the pulleys rotatably positioned adjacent opposing sides of the flow path such that the belt extends transversely across the flow path.

11. A machine according to claim 10, wherein the feeder includes a second feeder head through which elastic bands are fed onto the material, said second feeder head being mounted on the belt and cooperating with the first feeder head to deposit elastic bands on the first material in a pair of opposed curved contours.

12. A machine according to claim 10, wherein the belt has a first and second linear belt portion positioned on opposite sides of the pair of pulleys, the first and second linear belt portions moving in opposing directions transverse of the flow path when the belt is moved;

the first feeder head being fixed to the first belt portion; and

a second feeder head fixed to the second belt portions, elastic bands being guided through the second feeder head, and the first feeder head and the second feeder head movable in opposing directions along the linear path when the belt moves, the first and second feeder heads feeding elastic bands to the first material on the conveyor in a pair of opposed curved contours.

13. A machine according to claim 10, further comprising a belt drive device that reciprocatively drives the belt in opposite directions.

14. A machine according to claim 13, wherein the belt drive device has a cam drivingly connected to the belt, the cam driving the belt at selected variable speeds during belt reciprocation so that the elastic bands are fed onto the first material carried on the conveyor in a selected curved contour.

15. A machine according to claim 12, further comprising a drive device linked to the belt and operable to drive the belt at varying speeds.

16. A machine according to claim 8, further comprising a tensioning device through which the plurality of elastic bands are guided, the tensioning device maintaining the elastic bands under a substantially constant tension as the elastic bands are fed onto the first material carried on the conveyor.

17. A machine according to claim 8, further comprising:

a first elongate nip roller positioned adjacent and parallel to the linear path and in rolling contact with the conveyor at a first nip in order to press the elastic bands onto the conveyer at the first nip, the the first nip roller operable to carry a second material and apply the second material onto the first material carried on the conveyor over the elastic bands to encase the elastic bands between the first and second materials.

18. A machine according to claim 17, wherein the feeder head is positioned in close proximity to the first nip.

19. A machine according to claim 8, wherein the feeder head has first and second arcuate surfaces on which respective first and second outermost elastic bands are guided, the arcuate wall portions defining a central axis that extends at a substantial angle relative to the material flow path.

20. A machine according to claim 19, wherein the feeder head has a central feeding aperture coaxial with the central axis, a central elastic band guided through the central feeding aperture, the feeder head feeding the two outermost bands and the central band onto the first material with a fixed spacing between the central band and the both of the outermost bands.

21. A machine according to claim 19, wherein the feeder head has a central feeding aperture coaxial with the central axis, a central elastic band guided through the central feeding aperture, and the first arcuate surface, second arcuate surface, and central aperture each having a different longitudinal position along the central axis.

22. A machine according to claim 8, further comprising an elastic gripper positioned laterally outboard of the material on the conveyor, the gripper being movable in said one direction at a speed equal to the speed of the conveyor; and

the feeder head applying elastic to the material is movable laterally to a position adjacent the gripper, allowing the gripper to receive and grasp portions of the elastic bands outboard of the first material.

23. A machine according to claim 22, further comprising cutters positioned laterally outboard of the first material, operable to sever the elastic bands outboard of the first material after the elastic bands have been grasped by said elastic grippers.

24. A machine according to claim 8, wherein:

the feeder head feeds the individual elastic bands from platforms having differing elevational levels; and

the gripper includes a gripper body defining a plurality of elevationally spaced holding bays adapted to receive the individual elastic bands at differing elevational levels, the gripper including a locking member shiftable between a lock position operable to close the holding bays to grip said elastic bands and an unlock position operable to release the elastic bands, and said gripper body being biased toward said lock position.

25. A machine according to claim 8, wherein the conveyor comprises a rotatable conveyor drum for carrying the first material on a peripheral drum face along the flow path.

26. A machine according to claim 8, further comprising an adhesive applicator operable to apply adhesive to secure the elastic to the first material.

27. A machine for applying elastic to material, comprising:

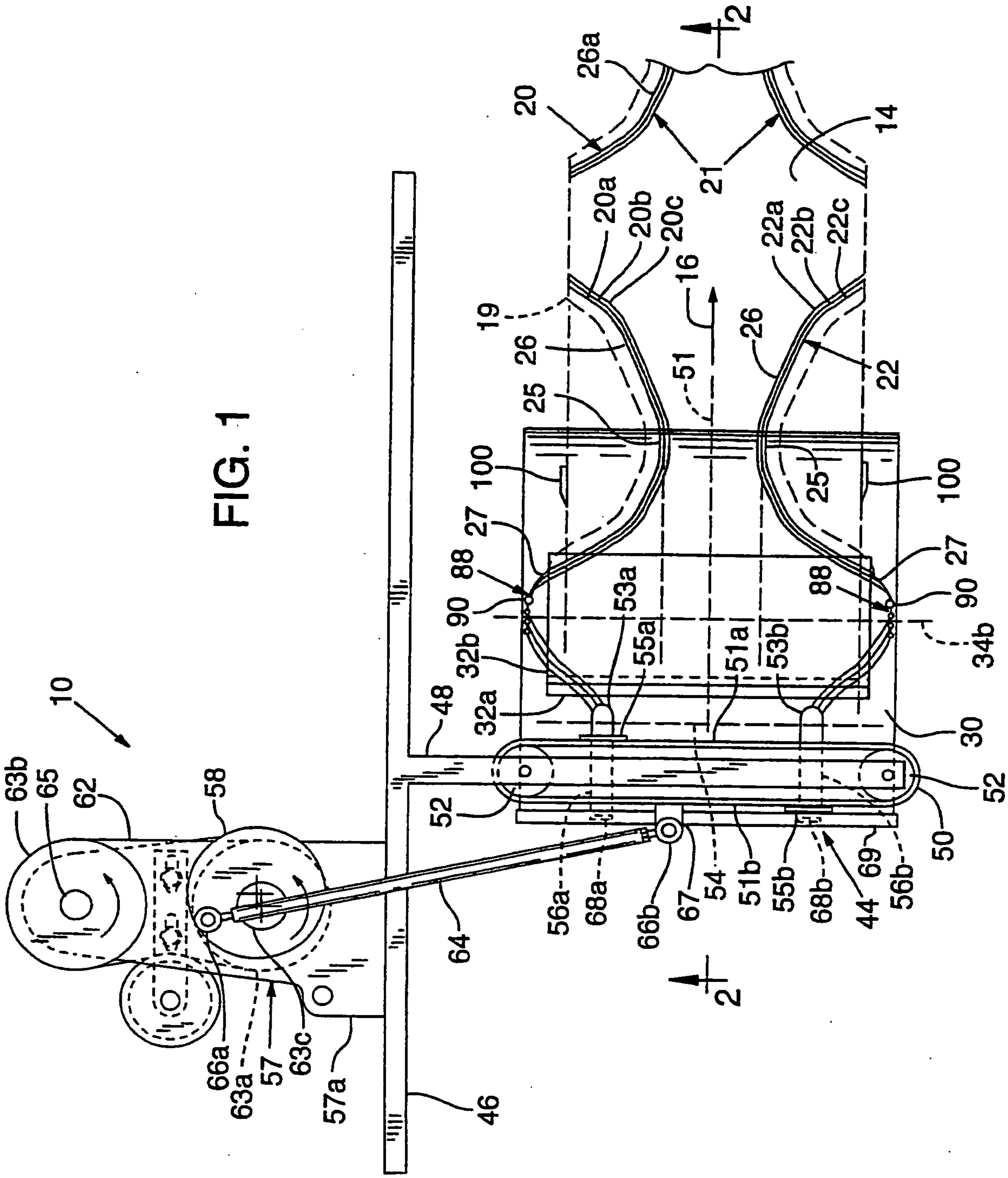
a conveyor moving in one direction along a flow path and operable to carry material for garments;

a first nip region defined on the conveyor transverse of the flow path;

an elastic band storage for providing a quantity of a plurality of elongate elastic bands;

an elastic feeder having a feeder head for feeding the plurality of elastic bands onto the conveyor, the feeder head movable to feed the elastic bands onto the conveyor in a curved contour at the first nip region, the feeder head being spaced a constant distance from the first nip region while feeding the elastic bands, the feeder head feeding the elastic bands onto the conveyer with a substantially constant perpendicular spacing between individual bands throughout the curved contour.

28. The machine according to claim 27, wherein athe elastic bands are encased between a first material and a second material at the first nip region.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68b
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56b
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32b
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55a
53a
51a
53b
30
34b
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14
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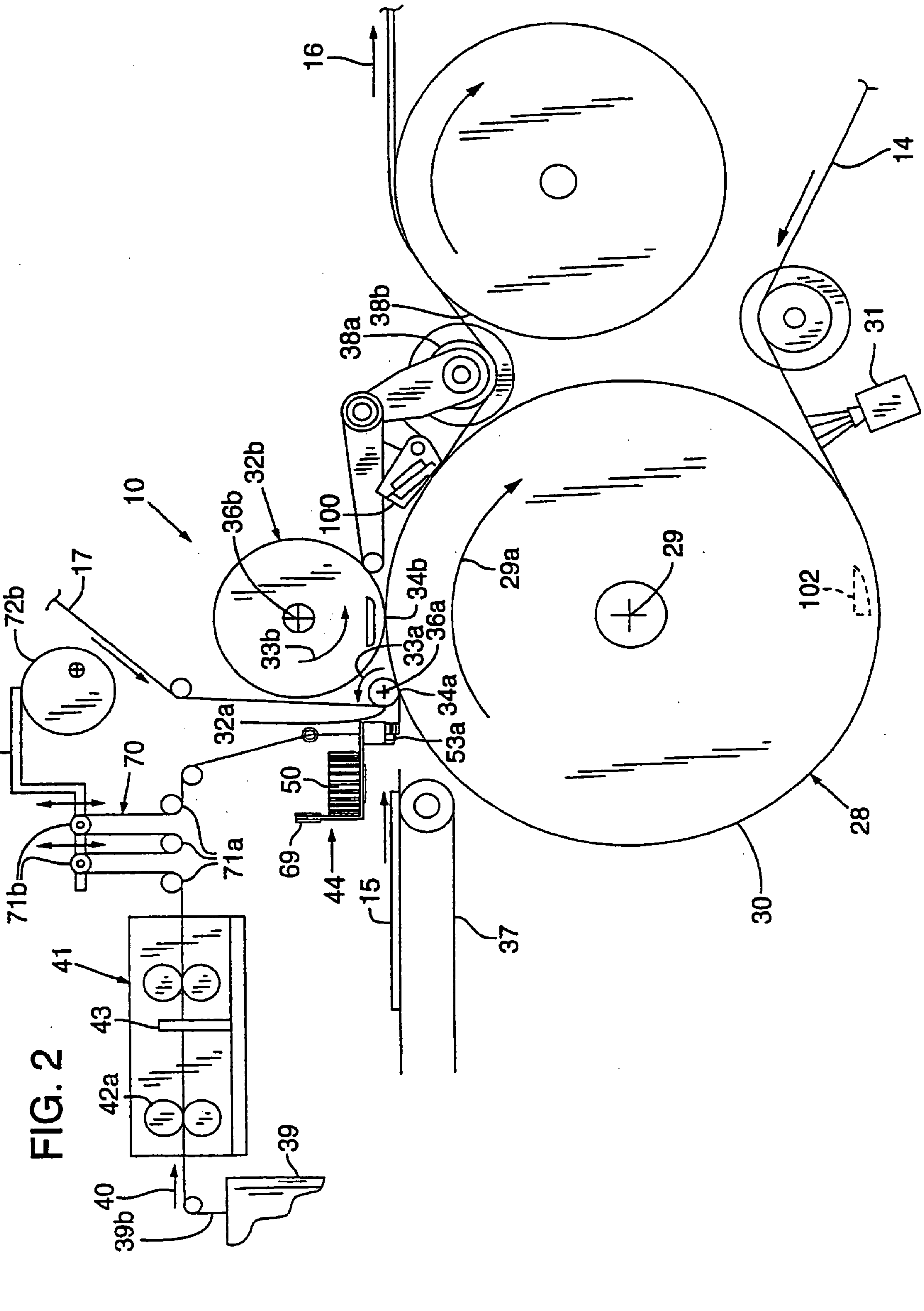
26a
2

FIG. 1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32a
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42a
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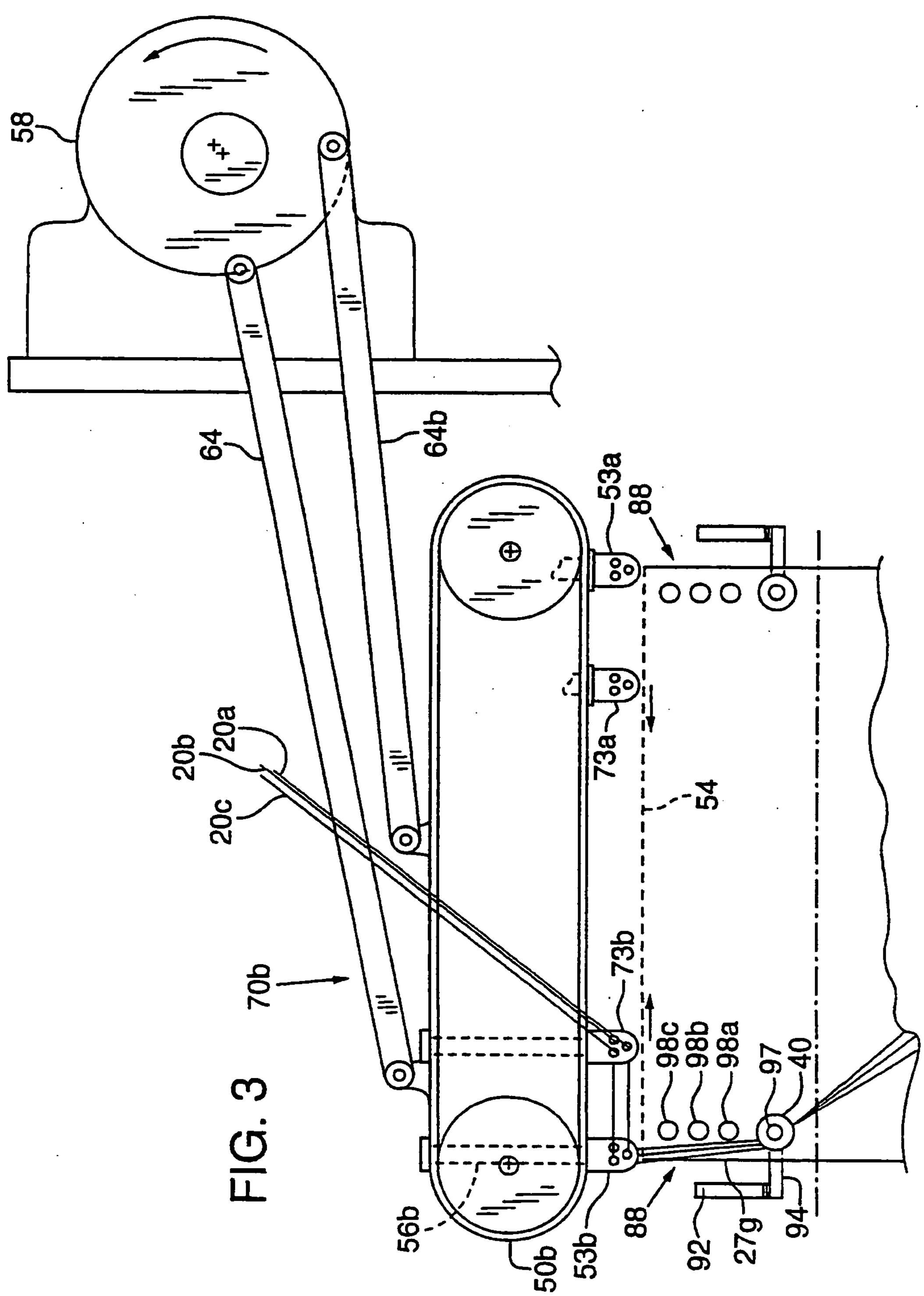
39b

FIG. 2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20a
20c
70b
73b
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98b
98a
97
40
56b
50b
53b
88
92
27g
94

FIG. 3

FIG. 4

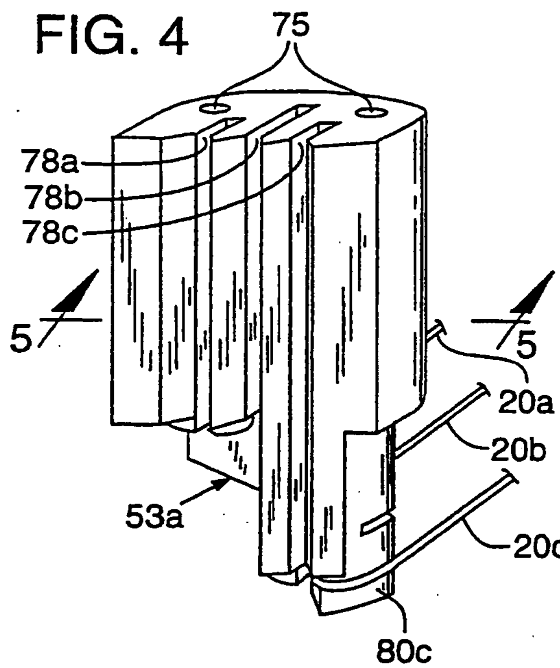


FIG. 5

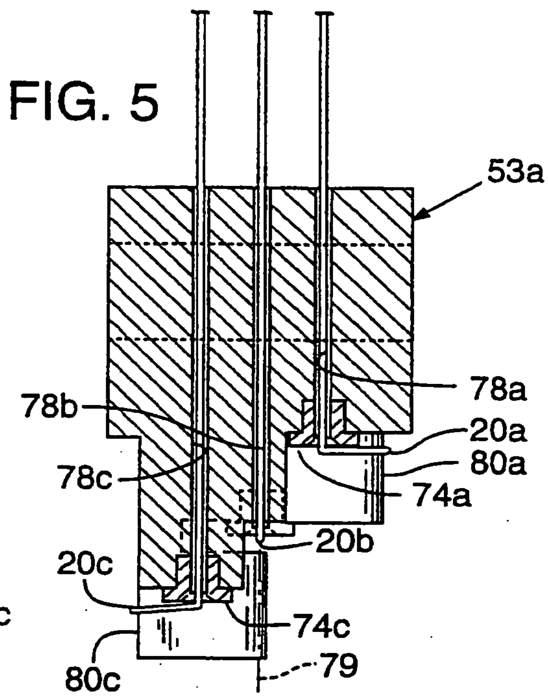


FIG. 6

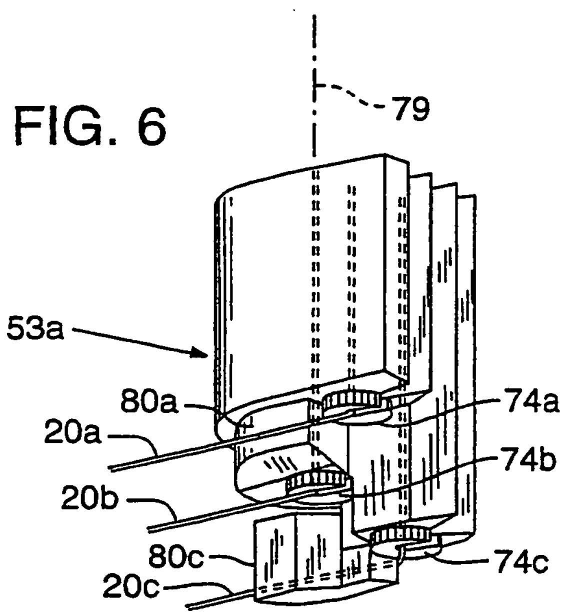
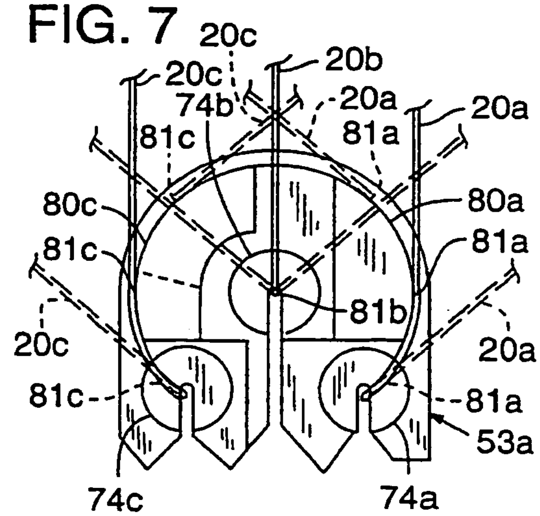
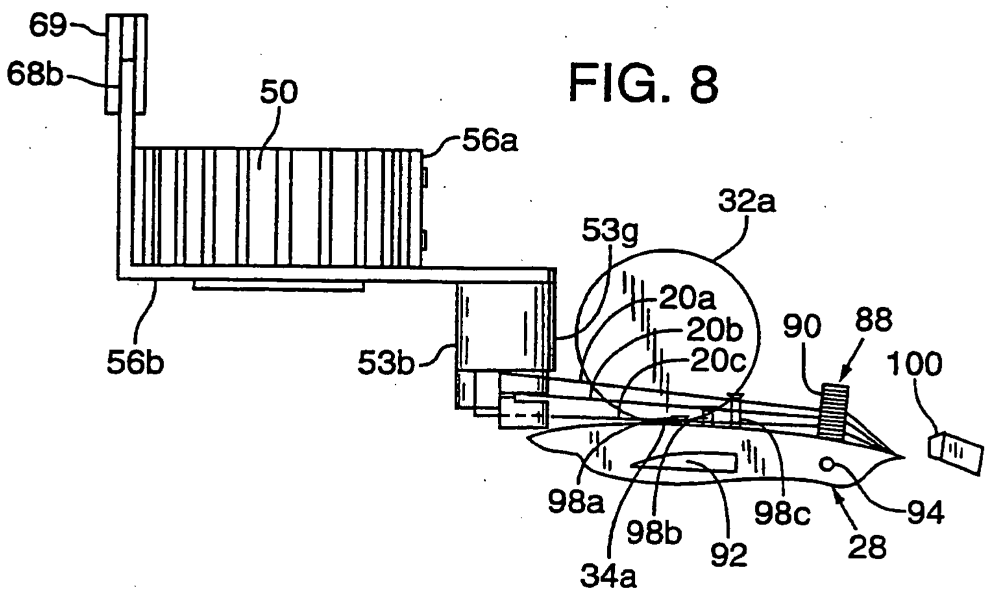


FIG. 7

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68b
50
56a
56b
53b
53g
32a
20a
20b
20c
90
88
100
98a
98b
98c
34a
92
94
28

FIG. 8

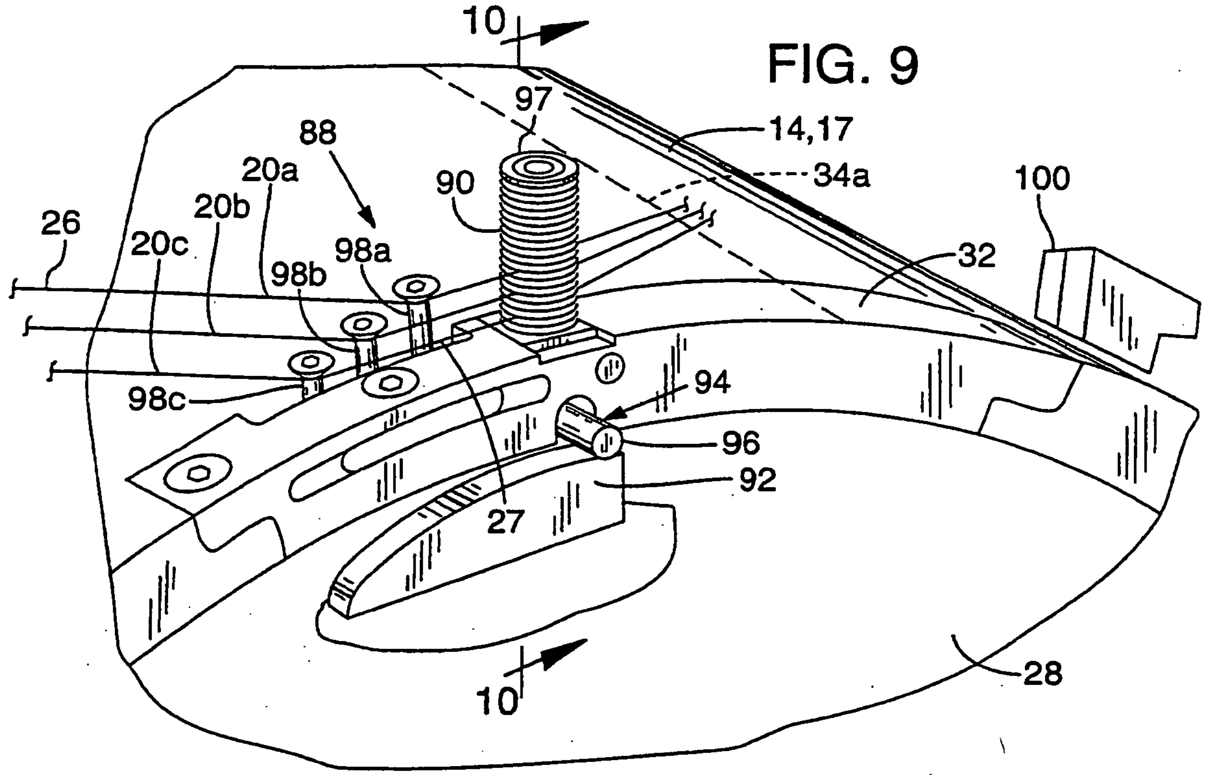

10
97
88
14,17
34a
100
90
20a
20b
26
20c
98a
98b
32
94
98c
96
92
27
28
10

FIG. 9

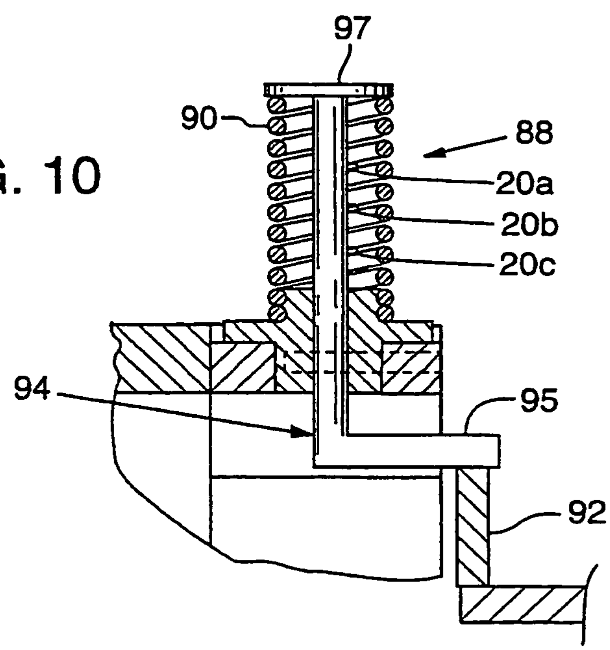

97
90
88
20a
20b
20c
94
95
92

FIG. 10

FIG. 11

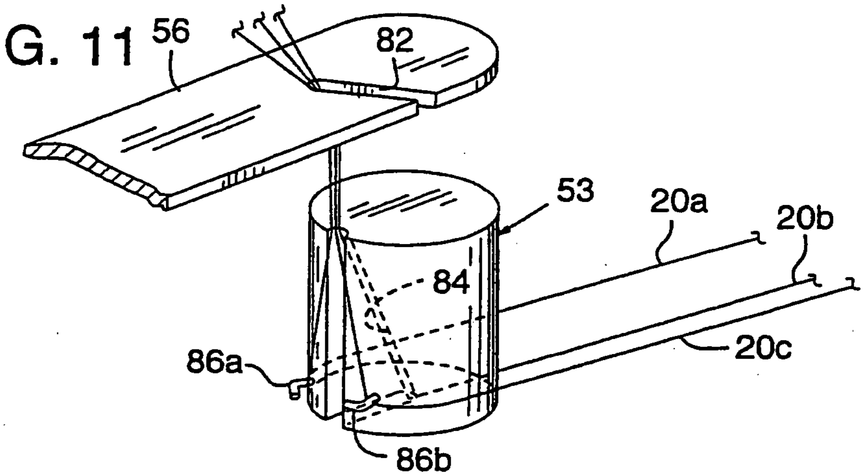


FIG. 12

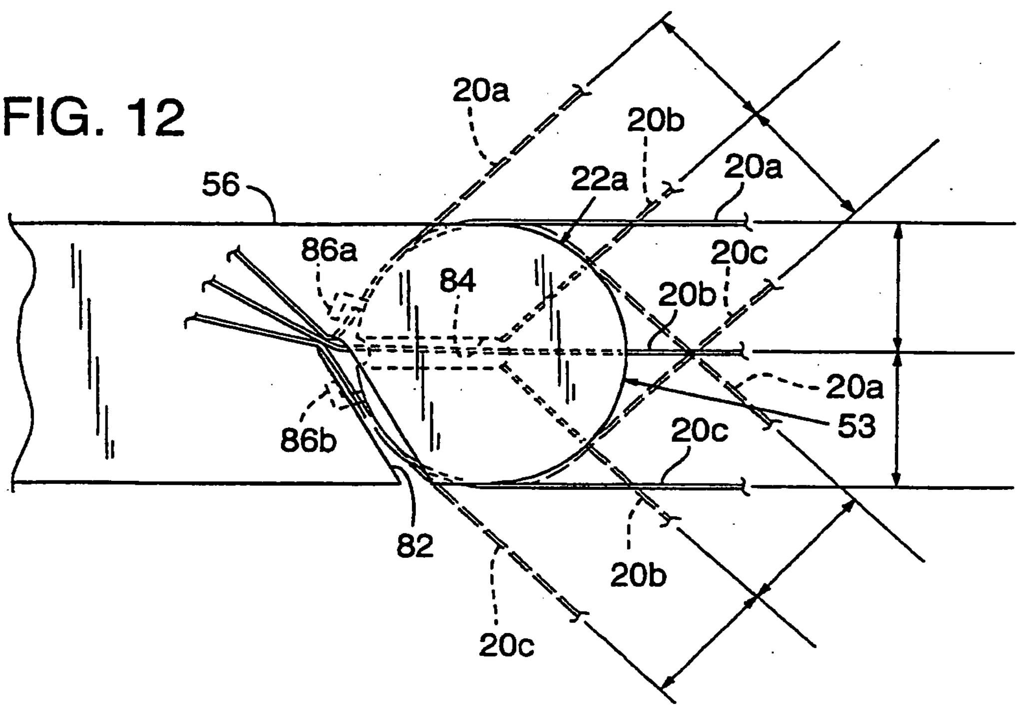


FIG. 13

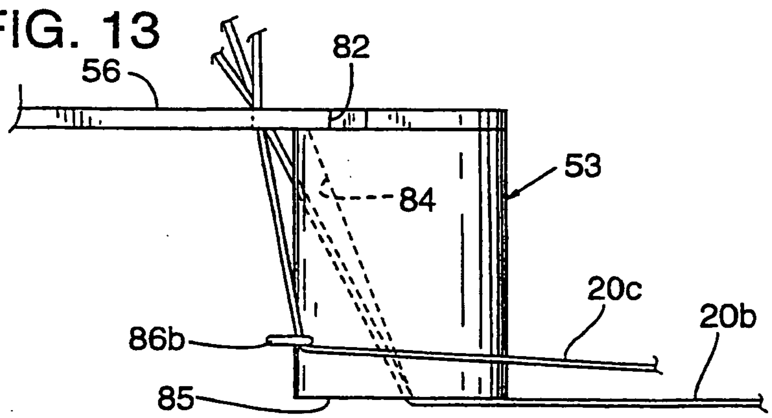
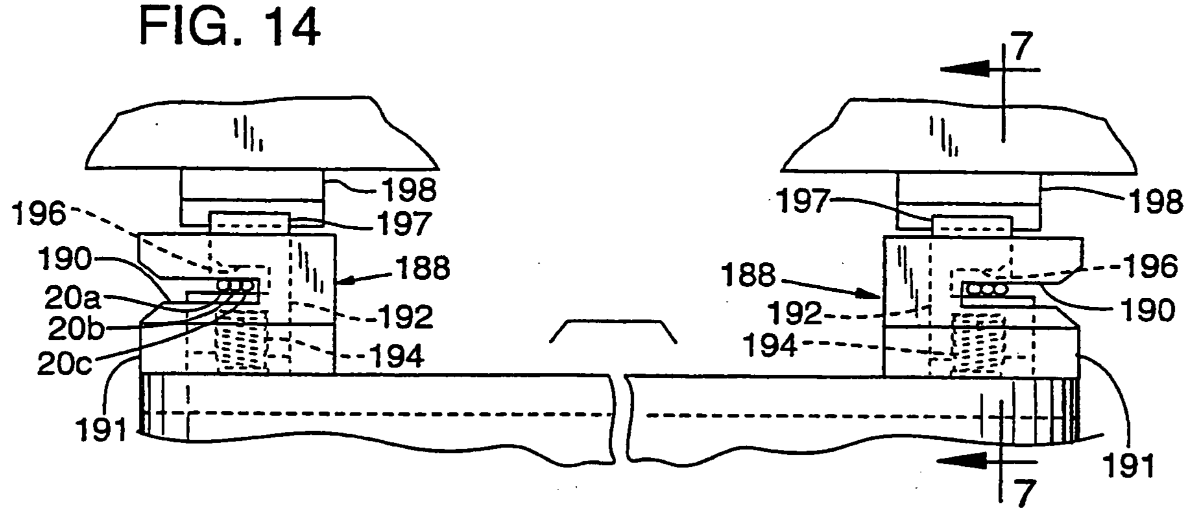


FIG. 14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197
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188
20a
20b
192
20c
194
191
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198
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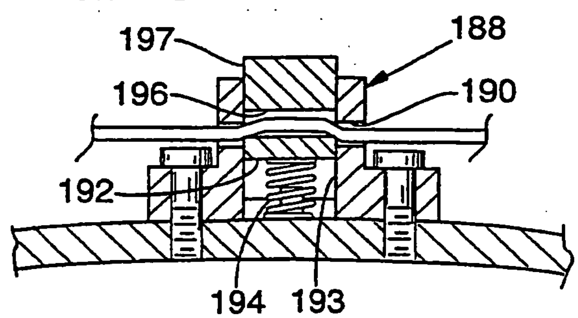
194
191

FIG. 15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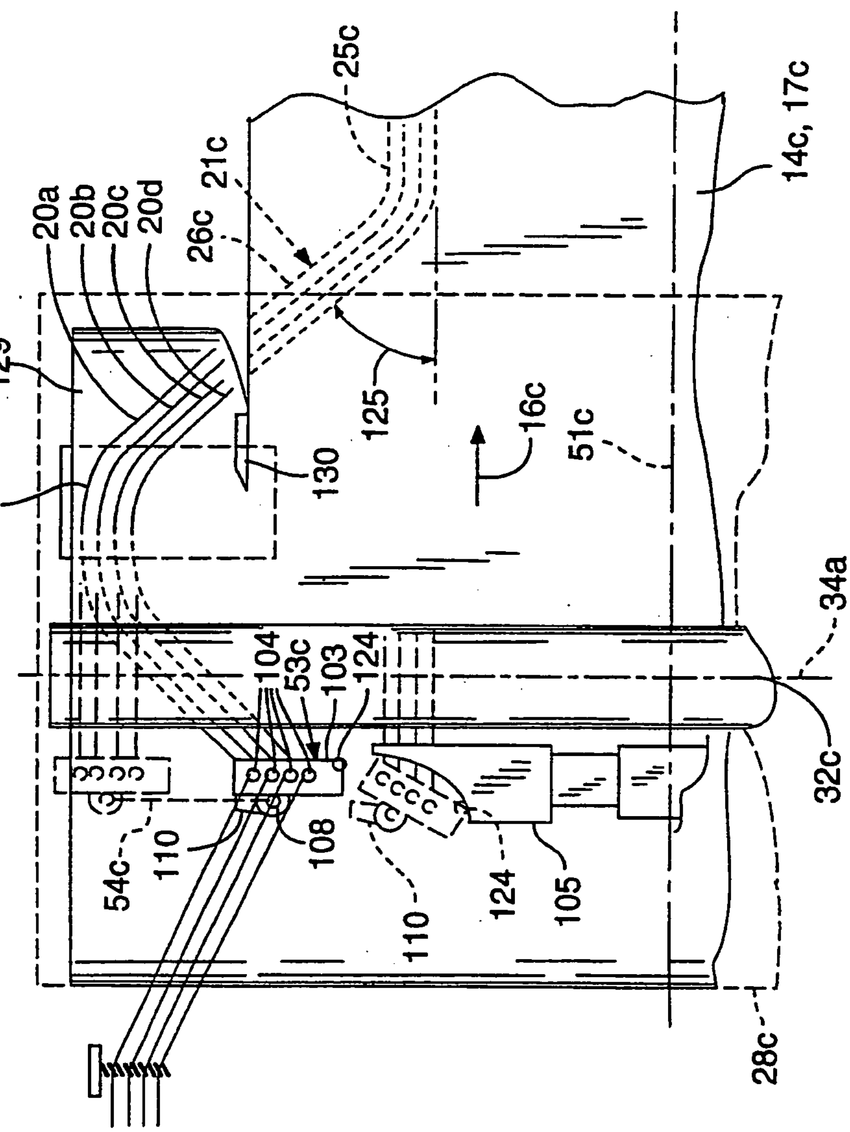
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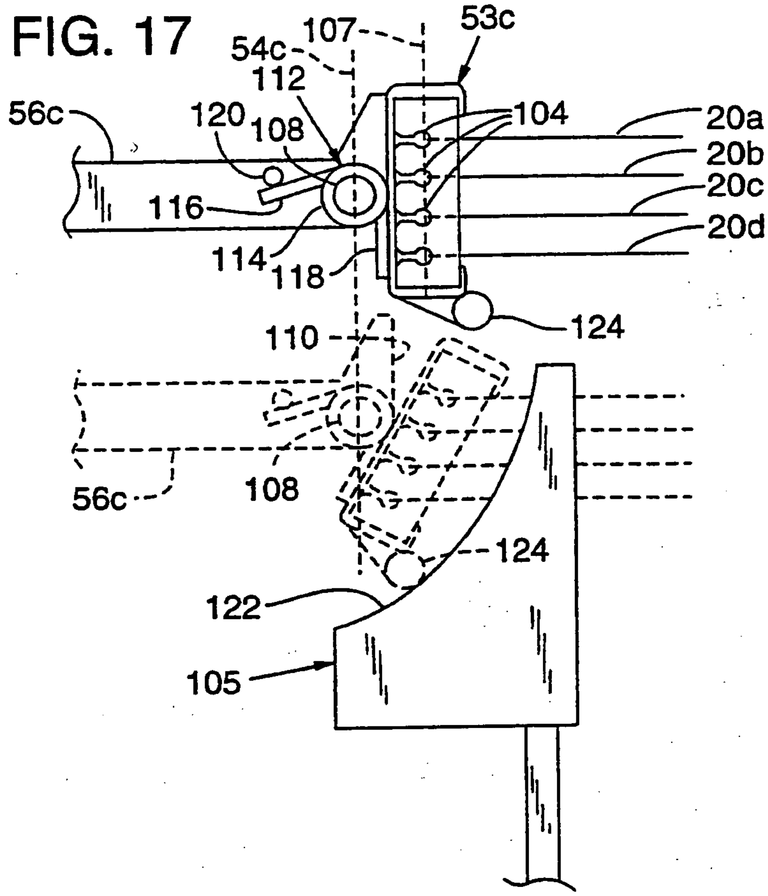
20c
20d
21c
25c
26c
14c, 17c
129
125
27c
130
16c
51c
34a
104
53c
103
124
32c
54c
110
108
124
105
110
28c

FIG. 16

FIG. 17


54c
107
53c
112
56c
120
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104
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20b
20c
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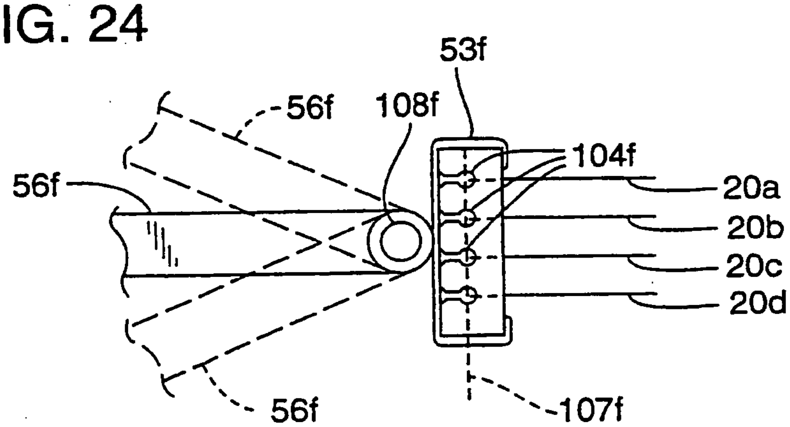
116
114
118
124
110
56c
108
124
122
105

FIG. 24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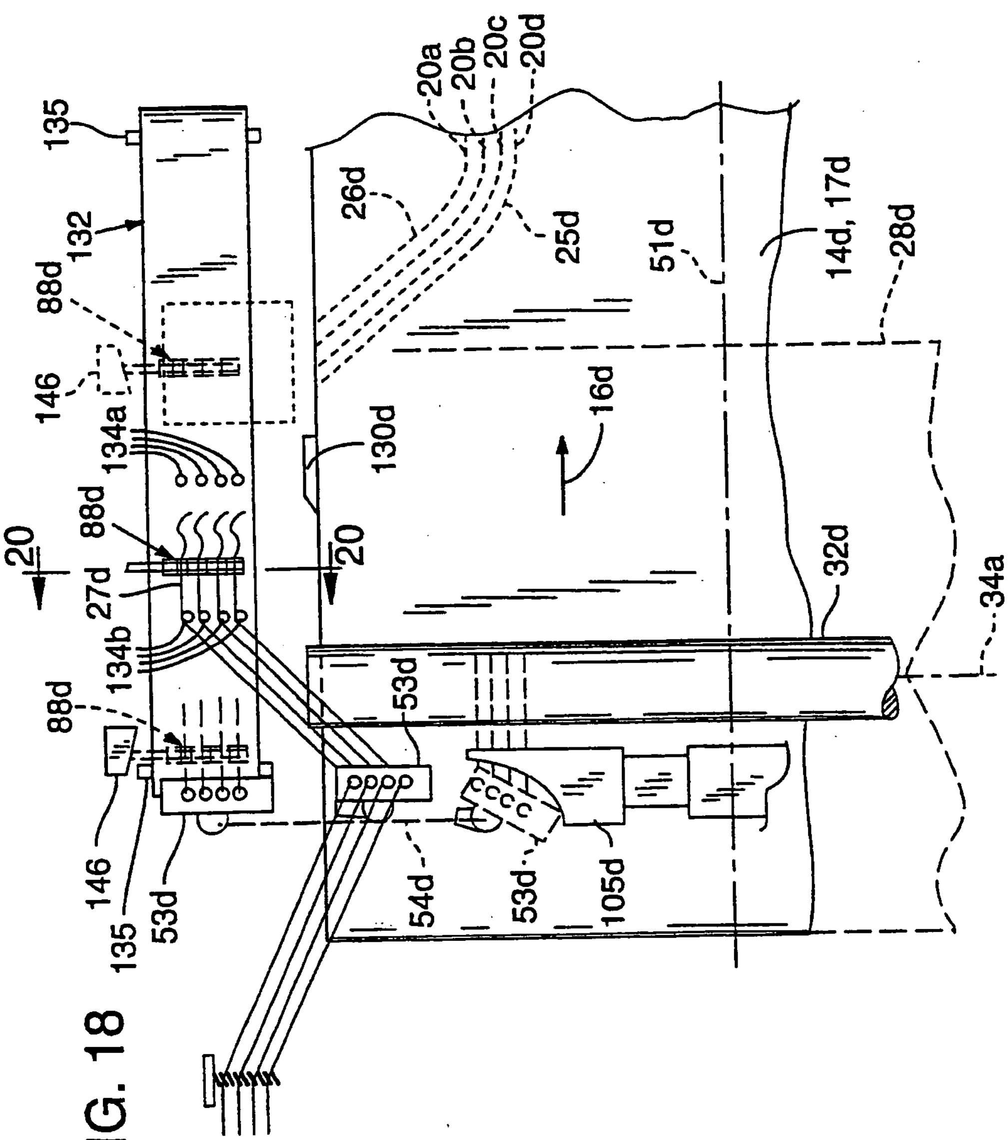
56f
108f
104f
56f
20a
20b
20c
20d
56f
107f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132
88d
146
134a
88d
20
27d
134b
88d
146
135
53d
20a
20b
20c
20d
26d
25d
51d
14d, 17d
28d
16d
130d
20
32d
34a
53d
54d
53d
105d

FIG. 18

FIG. 19

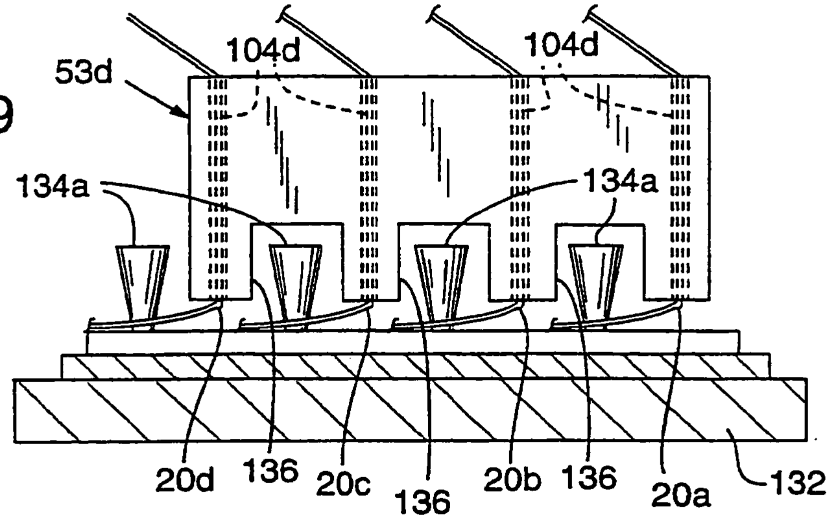


FIG. 20

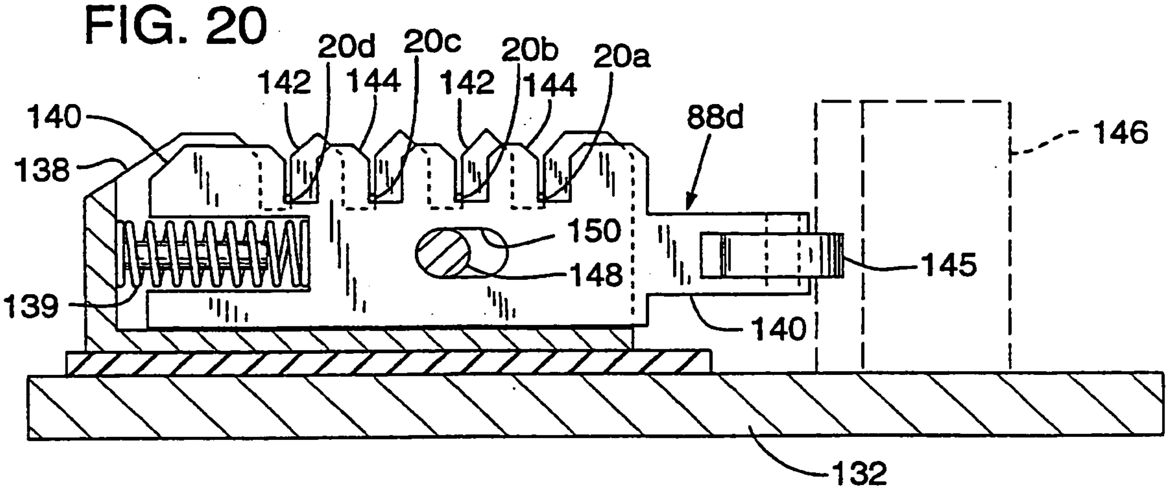
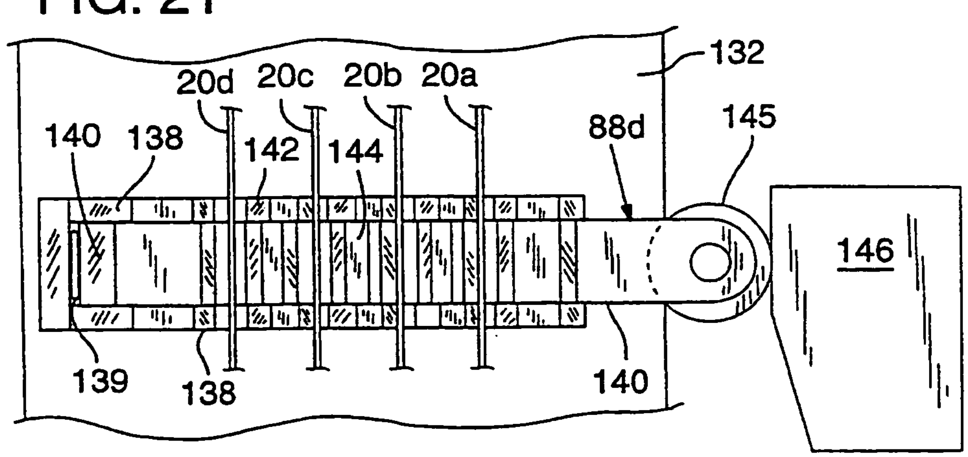
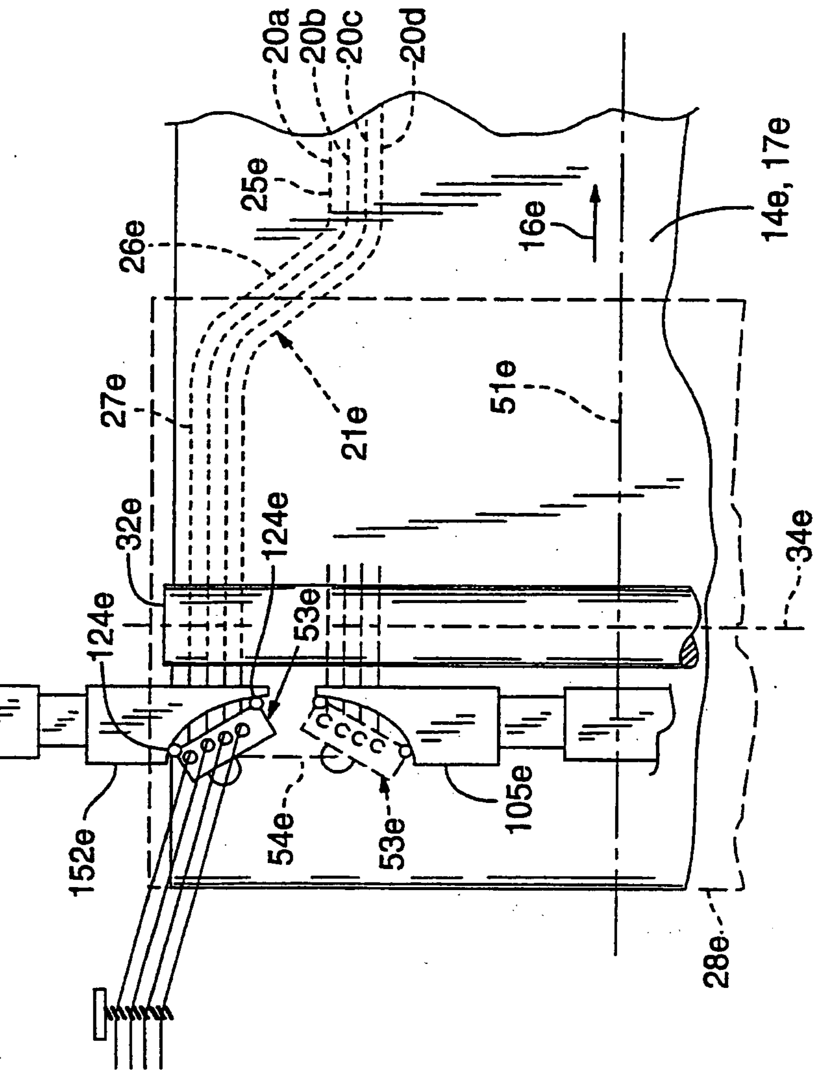


FIG. 21

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16e
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27e
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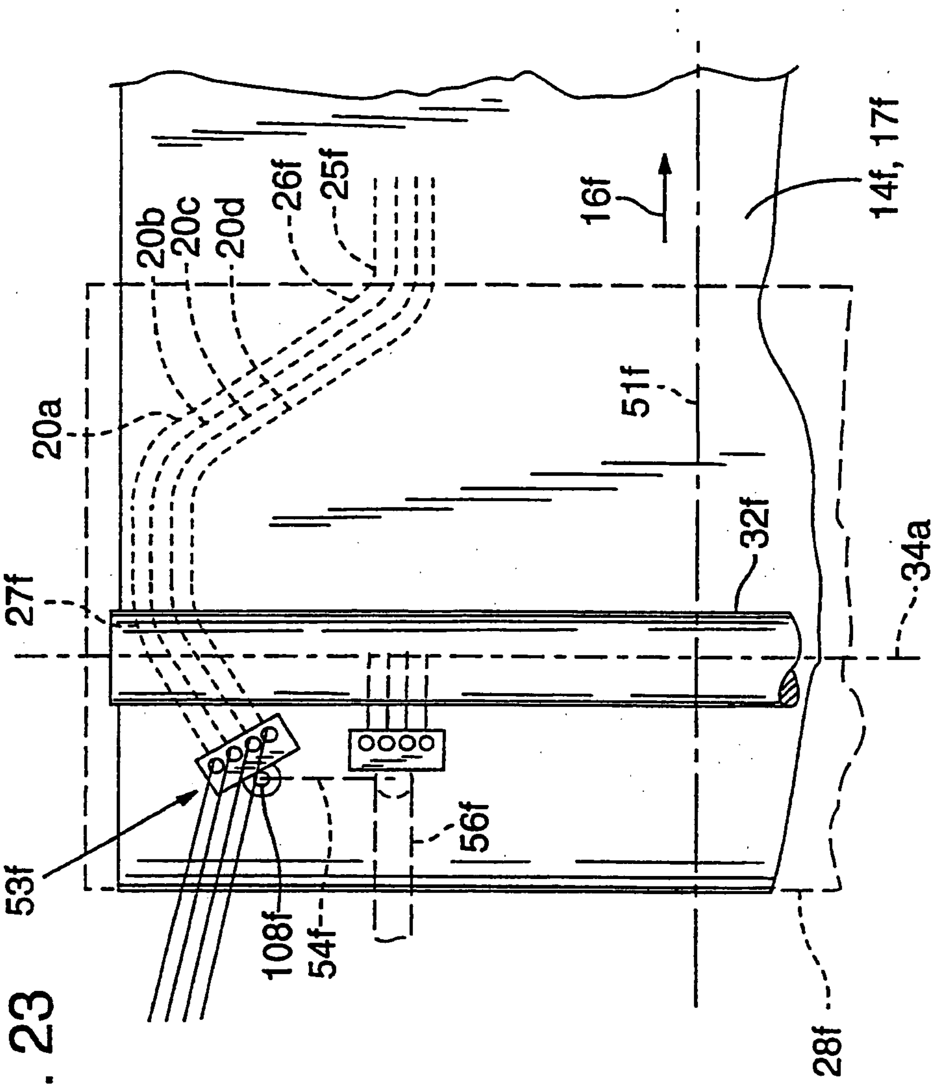
51e
32e
124e
124e
53e
34e
152e
54e
53e
105e
28e

FIG. 22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26f
25f
16f
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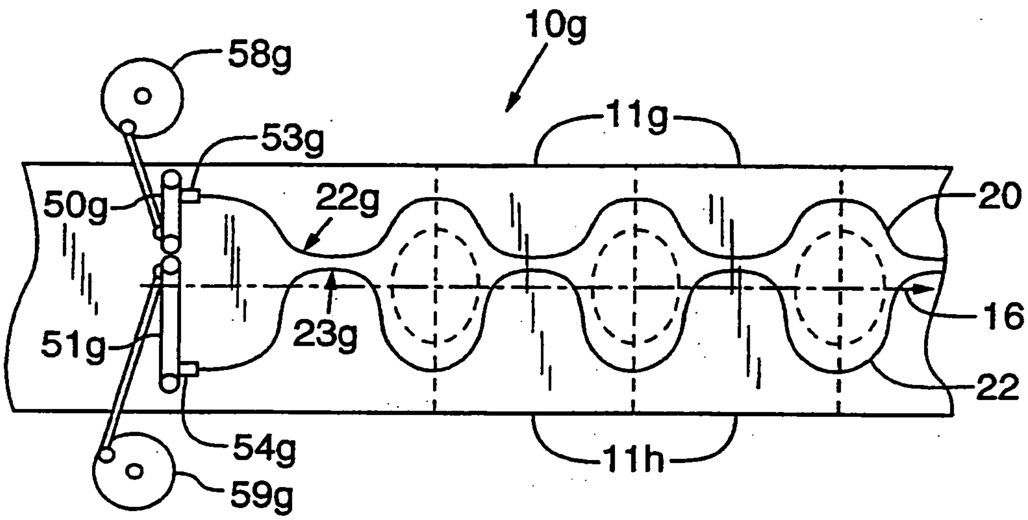
20a
51f
32f
34a
27f
56f
53f
108f
54f
28f

FIG. 23

FIG. 25



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US96/04379

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : A61F 13/15
US CL : 156/161,163,164,229,436,439,494,496,552,556; 604/385.1,385.2
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 156/161,163,164,229,436,439,494,496,552,556; 604/385.1,385.2

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

none

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

none

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,389,173 A (MERKATORIS, ET AL) 14 FEBRUARY 1995 (14.02.95), entire document.	1-28
Y,E	US 5,525,175 A (BLENKE, ET AL) 11 JUNE 1996 (11.06.96), entire document.	1-28

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 JUNE 1996	11 JUL 1996

Name and mailing address of the ISA/US	Authorized officer
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